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ABSTRACT

Noting that four of the six most common readability formulas use the McCall-Crabbs Standard Test Lessons in Reading as the independent criterion of difficulty to establish validity, while the other two often site their correlation with the first four to determine validity, a study examined whether these lessons consisted of passage selections covering a sufficiently wide range of reading difficulty to warrant their use in the development of readability formulas. It was hypothesized that the lessons should increase in difficulty from the beginning of any given booklet to the end, and from Book A to Book D. However, results of analysis showed that the average number of sentences and the average number of syllables per 100 words did not support the assumption that the complexity of the material increased within books or from Book A to Book D. Among the formulas there is considerable variation in grade level designation for the reading selections. The results increase concern about relying on any formula that uses the McCall-Crabbs Standard Test Lessons in Reading as a criterion for development or that bases its validity upon the correlation with other formulas as its justification for application. The results also indicate that readability formulas do not provide school librarians with the information needed to match a given book with a particular student or group of students. (Tables of data are included.) (HTH)

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Readability Concerns for the School Librarian

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Running head: READABILITY CONCERNS

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Abstract

The purpose of this study was to determine whether the McCall-Crabbs Standard Test Lessons in Reading were selections of passages covering a sufficiently wide range of reading difficulty to warrant their use as a criterion for the development of readability formulas. The results of the study indicated that the McCall-Crabbs lessons do not increase in reading difficulty, either within the individual books (A-D), or among the books, to the extent assumed by those who used the lessons as the criterion for the development of the formulas. The basic assumption upon which several readability formulas have been developed is suspect and the conclusions and extended logic that have developed with respect to their use are erroneous.

A Question of Readability Validity

The prospect of measuring the readability of a text by means of the application of a simple formula has been a reality since 1923, with the publication of the formula developed by Lively and Pressey. Since that time over thirty-five formulas have been developed for use by educational publishers designing basal readers, remedial reading materials and other reading materials designed for specific target populations. In several states within the United States and provinces in Canada instructional materials are approved only if they fit certain readability criteria.

Four commonly used readability formulas for the middle grades and above were analyzed in this study: (a) Dale-Chall, (b) Gunning-Fox Index, (c) Flesch Reading Ease Formula, and (d) McLaughlin SMOG Grading. In addition, Spache and Wheeler/Smith formulas were analyzed for evaluating primary grade materials.

The first four of the readability formulas share a common problem in their development with respect to the criterion. The McCall-Crabbs Standard Test Lessons in Reading (McCall & Crabbs, 1925, 1950, 1961) were never standardized, nor were they intended for the research purposes for which they have been employed. Stevens (1980), in a personal communication in 1978 with William McCall, reported that McCall said, "When, last year, I learned for the first time the number of readability formulae resting on my G (grade level) scores, I was vastly surprised. . . . Probably all the formulae were defensible

during the crude early days of scientific education. The formulae builders never approached me as you have done." In spite of this denunciation of the use of the McCall-Crabbs "graded" selections, earlier comments by some readability authorities have been widely read and accepted. Klare (1974-75) for example stated: "These lessons (the McCall-Crabbs Standard Test Lessons) have been convenient statistically because they are a large number of reading passages, covering a wide range of difficulty, resting upon extensive testing and providing detailed grade scores."

A predictive formula for readability can be only as good as the criterion upon which it is based. The basic assumption is that the McCall-Crabbs material represents a valid and reliable criterion. In order to better understand the magnitude of the problem, a closer look at the formulas used for this study may be in order. A summary presentation of readability formulas may be found in Tables 1 - 7.

Insert Table 1 about here

Flesch (1948)

The Flesch Reading Ease Formula is a relatively simple formula with factors measuring aspects of the difficulty of reading single words and sentences. Numerous validity studies for this formula have been reported (Klare, 1963). These studies use a variety of different criteria, such as comprehension test scores and expert judgment. The

Table 1

Flesch (1948) Reading Ease Formula

Formula	Method of ranking material	Validity and reliability
R.E. = 206.835 - .846 wl - 1.015 sl	Selections from adult magazines and McCall-Crabbs lessons	Validity: R = .64 and .70 with McCall-Crabbs scores Reliability: None

highest correlations reported are usually between the Flesch and other readability formulas. These data are not particularly useful since commonsense alone would indicate that the correlation would be high if the internal factors for measuring readability and the criterion base were the same. The results of the correlation on the criterion measure, McCall-Crabbs Lessons, with all formulas have a measure of correlation at a significant level.

Insert Table 2 about here

Dale-Chall (1948)

The sentence and word factors in the formula are the same as in the Flesch formula. It can be argued that the percentage of words outside the Dale list of 3,000 (X_1 or Dale score) measures the same influence as the Flesch syllable count. The word factor may be seen as a measure of semantic difficulty since the syllable count is a reflection of word length and higher syllable counts reflect a measure of degree of usage, and therefore difficulty of meaning. Words found in the Dale list were selected by questioning a sample of fourth-graders who checked the words they knew. A word was included on the list when 80% of the sample had sight knowledge of the words. Other word lists (Thorndike & Lorge, 1944; Carroll, Davies & Richman, 1971) were compiled on the basis of the number of times a lexical item appeared in a cross-genre sample of selected texts.

Table 2

Dale-Chall (1948) Formula

Formula	Method of ranking material	Validity and reliability
$C_{50} = .1579X_1 + .0496X_2 + 3.6365$ where: X_{C50} = reading grade score of a pupil who could answer 50% of the test questions on a passage correctly; X_1 = Dale score, or percentage of words outside the Dale list of 3,000; X_2 = average sentence length in words	The McCall-Crabbs Standard Test Lessons in Reading (1925) were used as a criterion (50% comprehension)	Validity: R = .70 with Gray-Leary Reading Tests Reliability: None

Insert Table 3 about here

Gunning (1952) The "Fog Index"

The Fog Index is clearly similar to that of the Flesch and Dale-Chall in that the factors remain the same but the counting of three-syllable words is easier and requires less time than the syllable count required by Flesch.

Insert Table 4 about here

McLaughlin (1969) SMOG Grading

The SMOG predicts readability on the basis of one factor, polysyllabic words. It is therefore limited to those factors related to the identification and processing of words.

A comparison of the Fog Index and SMOG grading showed the highest correlation (.67). A comparison of readability grade levels with Dale-Chall showed that the SMOG grades were usually two grades higher. This higher grade level designation is probably due to the use of a more severe criterion for the SMOG grading than the Dale-Chall formula: McLaughlin used one hundred percent success on McCall-Crabbs materials as the criterion for comprehension, while Dale and Chall employed a fifty percent comprehension score as their criterion.

Table 3

Gunning (1952) The "Fog Index"

Formula	Method of ranking material	Validity and reliability
Reading grade level = .4C average sentence length + percentage of words of 3 or more syllables	Magazines by Flesch formula and judgment, McCall-Crabbs at 90% comprehension	Validity: R = .59 with Fog Index Reliability: None

Table 4

McLaughlin (1969) SMOG Grading

Formula	Method of ranking material	Validity and reliability
SMOG = 3 + square root of polysyllabic word count	Selections from McCall-Crabbs lessons at 100% comprehension level	Validity: R = .09 with Dale-Chall, .65 with the Fog Index Reliability: None

Insert Table 5 about here

Spache (1953)

The Spache formula was designed for use with primary grade materials, as was the Wheeler and Smith formula. The sample (224) was drawn from 152 primary-grade textbooks according to level of classroom use based on publishers' designations. The Spache is the most highly correlated with the Dale-Chall (.63) which is not surprising since the bases for the formulas have a great deal in common.

Insert Table 6 about here

Wheeler and Smith (1954)

The Wheeler and Smith formula resembles the Spache in the sense that the criterion used was determined by publishers' grade designations for books. In the case of the Wheeler and Smith formula, combined means of nine basic reading series were used. Wheeler and Smith, who took a random word-count of the nine reading series, found the mean percentage of polysyllabic words for each level and the mean unit length for each level. The combined means were established as the criterion for each level. They felt that they might be criticized for giving equal weight to unit length, which is similar to sentence

Table 5

Spache (1953)

Formula	Method of ranking material	Validity and reliability
Grade-level of text-book = .141 average sentence length per 100 words + .086 words outside Dale 769 + .839	Basal reading books (129 books), social studies, health, and science (23 books) - according to level of classroom use - publishers' designations	Validity: R = .82 Reliability: None

Table 6

Wheeler & Smith (1954)

Formula	Method of ranking material	Validity and reliability
Percent of polysyllabic words x average unit length x 10. Obtained figure is read on table for grade placement.	Random word count of 9 basic reading series	Validity: R = .60 with Flesch Reliability: None

length. They were concerned that too much weight might be given to a factor generally considered to be less important than vocabulary. To counter this criticism, they pointed out that in every case throughout the nine series there was a clear increase in sentence length from grade to grade.

The application of readability formulas raises several concerns that should be mentioned. First, the formulas ignore much of the current knowledge and theoretical bases of the reading process. Most authorities would agree that the goal of reading is the comprehension of the written message. Because most of the formulas are based upon sentence length and word complexity (based on the number of syllables in the word) other factors that make a text difficult are measured only indirectly, if at all. The degree of abstraction, complexity and relationship of ideas, rhetorical structure, degree of discourse cohesion, dialect, text organization, and conceptual background of the reader are all eliminated from consideration in the formula approach. In addition, use to which the reader is to put the material is another missing factor in readability formulas. They do not take into account the factors of motivation, values, interest or purpose.

The second factor, which is the main focus of this paper, is the shaky statistical base upon which the formulas rest. A look at the pertinent assumptions upon which readability formulas rest may help in drawing some conclusions with respect to this weakness. The primary question relates to the criterion for the formulas.

Four of the six formulas used the McCall-Crabbs Standard Test Lessons in Reading as the independent criterion of difficulty to establish validity. The remainder of the formulas often cite their correlation with the first four in order to determine validity. Although this is a questionable technique, it is frequently used to establish a relationship by association. The McCall-Crabbs Standard Test Lessons in Reading consist of four booklets (A-D), each containing approximately seventy graded passages with multiple choice questions. The grade level assigned to each is alleged to be based on the number of correct responses by pupils of known reading achievement with each of the passages arranged from least difficult to most difficult within each booklet, and each book containing more difficult material in order.

If the McCall-Crabbs lessons are to be used as the basis to measure readability then there should be proof that the lessons increase in difficulty (readability level) from the beginning of any given booklet to the end, and from Book A to Book D. This should certainly be true if the readability formulas used to determine the difficulty level were the formulas that employed the McCall-Crabbs lessons as the criterion of difficulty.

If we consider (a) the number of sentences, and (b) the syllables per one hundred words as a measure of difficulty of material, the averages for these two factors do not support the assumption that Books A-D increase in complexity of material. The average number of

sentences per one hundred words is: 7.0, 7.4, 7.0 and 7.5 for Books A-D respectively. The average number of syllables per one hundred words is: 124.3, 121.7, 123.8 and 131.4 for Books A-D respectively. These data do not support the assumption that the McCall-Crabbs Test Lessons in Reading provide graded reading selections increasing in difficulty.

Insert Tables 7-10 about here

In comparing the mean grade level for Books A-D (Tables 7-10) using the Dale-Chall formula, it is found that there is a statistically significant difference between the first third and the last third of reading selections in Books A and D. The mean grade level for each third of the books, however, appears to be inappropriate for the grade level selections as assigned by McCall and Crabb.

The mean grade level for Books A-D (Tables 7-10), using the Fog Index, indicates a statistically significant difference between the first third and last third of reading selections in Books B and C. Within each book (B and C) the last third indicates considerably higher grade level than that designated by McCall-Crabb for the range of reading ability.

The mean grade level for Books B, C and D (Tables 7-10), using the Flesch formula, indicates a statistically significant difference between the first third and last third of the reading selections. The differences between the means for Book B were less than one year while

Table 7

Differences in readability scores for the first third and last third of McCall-Crabbs Test Lessons in Reading (Book A, Grades 2-4)

	Group	Mean	SD	SE	F-value	p
		Grade Level				
Flesch Formula	1st third	5.37	.64	.11	1.23	NS
	3rd third	6.51	.57	.09		
Dale-Chall	1st third	3.54	.21	.05	121.25	<.01
	3rd third	7.48	2.51	.05		
Fog Index	1st third	5.03	1.03	.18	1.40	NS
	3rd third	8.09	1.22	.22		
SMOG Index	1st third	4.76	1.17	.19	1.92	NS
	3rd third	6.69	.84	.14		
Spache Index	1st third	2.98	.50	.08	1.13	NS
	3rd third	3.85	.47	.07		
Wheeler-Smith	1st third	2.58	.87	.15	2.74	<.01
	3rd third	3.94	.53	.09		

Table 8

Differences in readability scores for first third and last third of McCall-Crabbs Test Lessons in Reading (Book B, Grades 3-5)

	Group	Mean	SD	SE	F-value	p
		Grade Level				
Flesch Formula	1st third	5.69	.38	.06	2.50	<.01
	3rd third	6.71	.61	.10		
Dale-Chall	1st third	6.68	.93	.18	2.55	NS
	3rd third	10.73	1.48	.29		
Fog Index	1st third	5.82	.82	.14	2.61	<.01
	3rd third	8.37	1.33	.23		
SMOG Index	1st third	5.24	.09	.14	1.07	NS
	3rd third	7.09	.86	.14		
Spache Index	1st third	3.20	.43	.07	1.72	NS
	3rd third	4.14	.56	.09		
Wheeler-Smith	1st third	2.82	.80	.13	1.83	NS
	3rd third	3.86	.59	.10		

Table 9

Differences in readability scores for first third and last third of McCall-Crabbs Test Lessons in Reading (Book C, Grades 4-6)

	Group	Mean	SD	SE	F-value	p
		Grade Level				
Flesch Formula	1st third	5.74	.52	.09	3.22	<.01
	3rd third	7.16	.93	.15		
Dale-Chall	1st third	7.56	.73	.14	1.35	NS
	3rd third	11.16	.85	.17		
Fog Index	1st third	6.03	.99	.17	3.51	<.01
	3rd third	9.49	1.85	.32		
SMOG Index	1st third	5.31	1.01	.16	1.60	NS
	3rd third	7.29	.80	.13		
Spache Index	1st third	3.45	.37	.05	2.29	<.01
	3rd third	4.42	.56	.09		
Wheeler-Smith	1st third	2.95	.90	.15	13.02	<.01
	3rd third	4.29	.25	.04		

Table 10

Differences in readability scores for first third and last third of McCall-Crabbs Test Lessons in Reading (Book D, Grades 5-7)

	Group	Mean	SD	SE	F-value	p
		Grade Level				
Flesch Formula	1st third	6.68	.56	.09	3.07	<.01
	3rd third	8.38	.98	.17		
Dale-Chall	1st third	9.38	.83	.16	3.65	<.01
	3rd third	14.09	1.58	.31		
Fog Index	1st third	7.94	1.37	.22	1.07	NS
	3rd third	11.32	1.41	.25		
SMOG Index	1st third	6.64	.89	.14	1.13	NS
	3rd third	8.51	.84	.14		
Spache Index	1st third	4.14	.48	.08	1.43	NS
	3rd third	5.29	.57	.10		
Wheeler-Smith	1st third	3.84	.75	.18	0.00	NS
	3rd third	4.50	.00	.00		

Books C and D indicate mean differences slightly in excess of two years.

The mean grade level for Books A-D (Tables 7-10), using the SMOG Index, indicates no statistically significant difference between the first third and last third of the reading selections in any of the McCall-Crabbs books.

The mean grade level for Book C (Tables 7-10), using the Spache Index, indicates a statistically significant difference between the first third and the last third of the reading selections. Analysis of the means reflects one grade level difference.

The mean grade level for Books A and C (Tables 7-10), using the Wheeler-Smith formula, indicates a statistically significant difference between the first third and the last third of the reading selections. The difference between the grade level means for Book A was less than one year.

Among the formulas there is considerable variation in grade level designation for the reading selections, both within each level book and among the books of the McCall-Crabbs Standard Reading Lessons, even in light of the knowledge that the Spache Index and the Wheeler-Smith Formula are for use in primary grade material. The results only increase concern about using any formula that uses the McCall-Crabbs Standard Test Lessons as a criterion for development, or that bases its validity upon the correlation with other formulas as its justification for application. An added concern that also enters into the discussion is the error factor of ± 1.0 year applied to

any grade level indicated by a formula.

Insert Table 11 about here

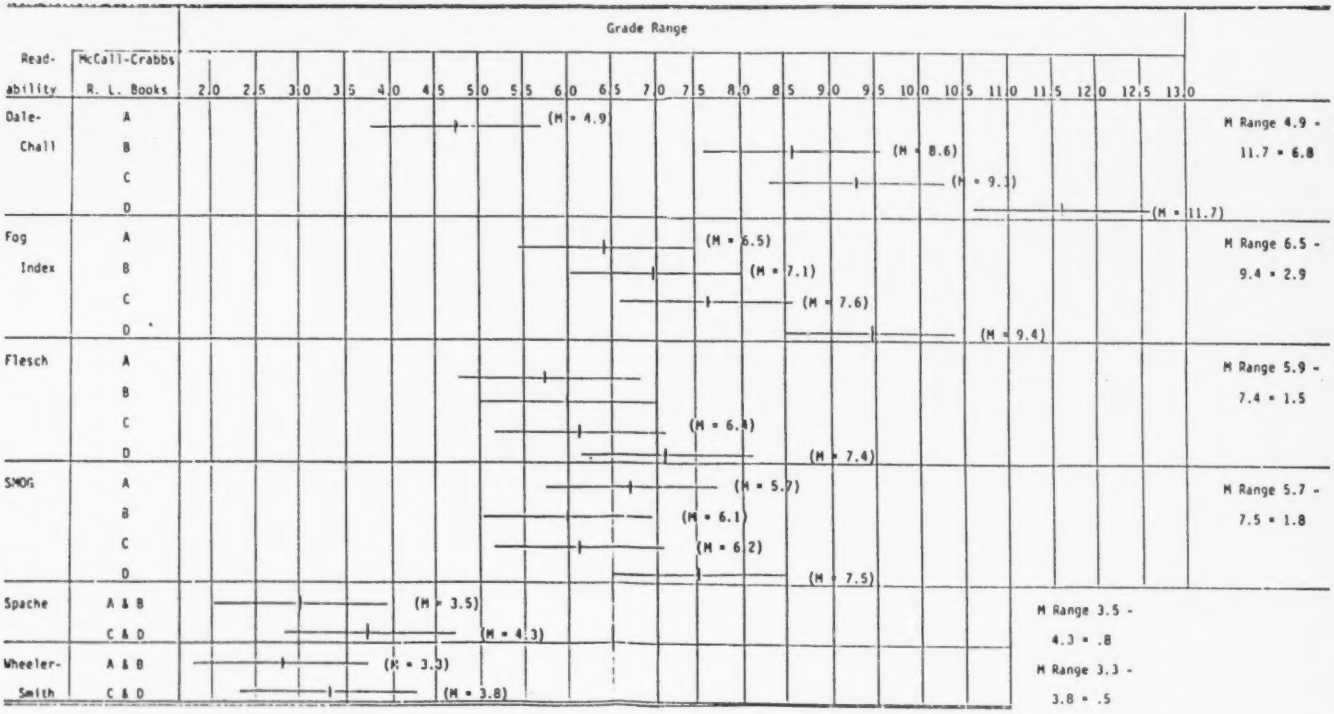
Another interpretation of the reading levels of the McCall-Crabbs lessons based upon the formulas cited is reflected in Table 11. The Dale-Chall formula appears to indicate a wider range of reading levels than any of the other formulas employed, with a mean grade level range of 6.8 years. There is an obvious clustering of similar level reading selections in Books B and C with a mean difference of only seven months. The mean grade level range for the Books A-D, using the Fog Index, is 2.9 years with a mean grade level range of 1.5 and 1.8 for the Fog and the Flesch Readability formulas respectively. The Spache and the Wheeler-Smith Readability formulas indicate a much lower reading grade level for Books A and B than the other formulas cited, and the range between Books A-B, C-D is extremely small: .8 months and .5 months.

Suggestion for Change

It is obvious from the previous comments that the readability formulas discussed do not provide the school librarian with the information that is needed to enable him/her to make intelligent decisions concerning the possible matching of a given book with a particular student or groups of students. One possible solution to the problem may be for the school librarian, for a period of one to two months, to keep a record of the students who borrowed each new

Table 11

Analysis of Readability Level of the McCall-Crabbs Standard Reading Lessons



Note: The range reflects the mean reading level for each book ± 1.0 (error).

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book in the library. At the end of each period of evaluation the students could be identified as to grade level and reading level. Perhaps it would also be possible, with the aid of the students' reading teacher, to complete a short evaluation form related to the difficulty of the book for the students, and the students' reaction to the book. The compilation of such data should provide a clear indication to the librarian as to the approximate level of reading ability needed to enjoy the book, and the possible interest range.

There is no easy answer to the solution of the identification of the readability level of a book. The best information we have available in making the appropriate match between student and book is the student's ability to read the material. It is entirely possible that we should reject the formula approach to readability (deductive readability) and consider INDUCTIVE READABILITY as the only viable approach.

Conclusion

Chall, in a recent publication (1984) indicated that readability formulas predict difficulty in terms of reading grade equivalents and not of grade placement. Chall assumes that a given readability grade level means that a student who reads at the same given grade level on a standardized reading test can be expected to read and understand material at about seventy-five percent accuracy on a multiple choice test, and that the level is reflected by the readability formulas. The data provided by this report do not support Chall's assumptions. If the readability formulas are based upon the McCall-Crabbs Standard

Test Lessons as their criterion for a standard, then the formulas themselves should indicate a difference in the difficulty levels from Books A-D. It is obvious from the data that the McCall-Crabbs Standard Test Reading Lessons do not increase in reading difficulty, either within the individual books or among the books, to the extent assumed by those who used the lessons as the criterion for the development of their formulas. The basic assumptions upon which readability formulas have been developed are indeed suspect and the conclusions and extended logic that have developed with respect to their current, and previous, use are erroneous. The only reasonable conclusions that can be reached, based upon the findings, are that the readability formulas were based upon unsound criteria, that the correlation research to support the use of other formulas (strength by association) has similar weaknesses, and finally that the folklore extrapolated from the unfounded assumptions places the question of the use of readability formulas in great jeopardy.

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